wherein said heat transfer medium consists essentially of a heat transfer medium gas, and said apparatus further comprises a gas passage, formed in said worktable, in order to supply the heat transfer medium gas between the sub-surface and said ring body.

REMARKS

Favorable reconsideration of this application is respectfully requested.

A separate letter to the Official Draftsperson has been sent to correct a typographical error in Figure 7. No new matter has been added.

Claims 1-3, 5-7, 9, 12, 14-17 and 19-24 are now present in this application, claims 4, 8, 10, 11, 13 and 18 being canceled and claims 21-24 being added by way of the present amendment. New claims 21-24 are believed to be supported by the specification and thus no question of introduction of new mater is raised. Claims 1, 13, 14 and 20 stand rejected under 35 U.S.C. §102(b) as being anticipated by JP-11330047 (Noda). Under 35 U.S.C. §103(a), claims 2, 3, 8, 15 and 18 stand rejected over Noda in view of U.S. 4,282,924 (Faretra), claim 4 stands rejected over Noda in view of Faretra and further in view of U.S. 6,148,765 (Lilleland et al.), claims 5, 6 and 17 stand rejected over Noda in view of U.S. 5,868,848 (Tsukamoto), claims 7 and 16 stand rejected over Noda in view of Faretra and further in view of U.S. 5,904,778 (Lu et al.), claims 9-11 and 19 stand rejected over Noda in view of Faretra and further in view of U.S. 5,405,491 (Shahvandi et al.).

Claim 12 stands objected to as being dependent upon a rejected base claim but would be allowable in rewritten into independent form. Applicants greatly appreciate the finding of claim 12 to recite patentable subject matter.

First, Applicants greatly appreciate the interview that took place between their representative and Examiners Kackar and Mills on September 17, 2002. It was explained how the worktable device of claim 1 and the plasma apparatus of claim 14 each recites a

worktable having a main surface for supporting a target surface and a sub-surface disposed around the main surface, a cooling mechanism disposed in the worktable and configured to supply coal to the main surface and the sub-surface, and a focus ring placed on the sub-surface and configured to surround the target substrate on the main surface. A heat transfer medium is interposed between the sub-surface and the focus ring to improve thermal conductivity between the sub-surface and the focus ring.

The Applicants have conducted research into the cause of the deterioration in process characteristics, which was seen on the peripheral portion of a wafer processed in a plasma processing apparatus. They found that the temperature of the focus greatly influences the process characteristics. For example, in a plasma processing apparatus, where a focus ring is heated to a temperature much above that of the wafer, the temperature of the periphery of the wafer becomes higher than that part of the wafer inside the periphery. The etching characteristics degrade on the periphery of the wafer. An example of such an alteration is shown in Figure 5, where the etching characteristics are altered in the edge of the substrate which is subject to be heated due to the rise in temperature of the focus ring.

The present invention provides a heat transfer medium between the sub-surface and the focus ring so that the focus ring can be cooled by heat transfer between the sub-surface and the focus ring, to avoid this disadvantageous effect.

In the main reference used against the claims, Noda, a different approach is used. In this reference differential cooling is used between the focus ring and the substrate, as pointed out in paragraph 24 where the focus ring is set at 20°C and the wafer chuck is set at 25°C. To accomplish this, a cooling mechanism for the focus ring is provided having a refrigerant pipe 7b and base-material 7a which consists of a thermally conductive material. The thermally conductive material in Noda is not provided to improve thermal conductivity between the lower electrode 3 and the focus ring, since these two are set at different temperatures. To the

contrary, Noda teaches that a separate cooling means 7 is provided and improving the thermal conductivity between the focus ring and the lower electrode 3 would disturb the temperature control and affect the differential temperatures. Clearly, Noda does not find any need to improve thermal conductivity between the lower electrode and the focus ring, and instead teaches that the desired temperature differential is obtained using the cooling means 7.

It was agreed at the interview that a claim reciting a single cooling means and a clamp would distinguish over the cited references. Claims 1 and 14 have been amended to recite a clamp and that there the cooling mechanism maintains the target substrate and the focus ring at substantially the same temperature. It is respectfully submitted that the combined references do not suggest such a device. The clamp improves the thermal conductivity between the sub-surface and the focus ring, which is not suggested and is in fact taught away from by Noda. In Noda, the temperature differential is needed since the desired goal it to prevent any deposit on the focus ring from flaking off onto the semiconductor wafer. Moreover, clamping the focus ring in Noda may interfere with the cooling means 7, and would possibly interfere with the control of the temperature of the focus ring and achieving the temperature differential. Moreover, Noda clearly does not teach maintaining the target substrate and the focus ring at substantially the same temperature, as the cooling means 7 is specifically provided to cool to the focus ring below that of the lower electrode 3. There is clearly no suggestion in Noda of the apparatus recited in claims 1 and 14.

The other cited references do not remedy the deficiencies of Noda. Withdrawal of the rejection of claims 1 and 14 is therefore respectfully requested.

It is respectfully submitted that the present application is in condition for allowance and a favorable decision to that effect is respectfully requested.

Respectfully submitted,
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IN THE CLAIMS

1. (Amended) A worktable device for a semiconductor process, comprising:

a worktable having a main surface for supporting a target substrate and a sub-surface disposed around said main surface;

a cooling mechanism disposed in said worktable and configured to supply cold to the main surface and the sub-surface;

a focus ring placed on the sub-surface and configured to surround the target substrate on the main surface; [and]

a heat transfer medium interposed between the sub-surface and said focus ring, said heat transfer medium being so disposed so as to improve thermal conductivity between the sub-surface and said focus ring to be higher than in a case with no thermal transfer medium; and

a clamp configured to press said focus ring against the sub-surface,

wherein said cooling mechanism maintains said target substrate and the focus ring at substantially the same temperature.

6. (Amended) The device according to claim [5] 22, wherein said heat transfer medium consists essentially of [a] an inert gas or a gas containing part of a composition of [an inert gas or] a process gas to be supplied around said worktable.

9. (Amended) The device according to claim [8] 1, [wherein said press mechanism comprises] comprising:

a clamp frame having a contact portion which comes into contact with said focus ring from above, and an extending portion extending downward from the contact portion along a side portion of side worktable.

14. (Amended) A plasma processing apparatus for a semiconductor process, comprising:

a hermetic process chamber;

a supply system configured to supply a process gas into said process chamber;

a supply system configured to supply a process gas into said process chamber;

an exhaust system configured to vacuum-evacuate an interior of said process chamber;

an excitation mechanism configured to excite and plasmatize the process gas;

a worktable disposed in said process chamber and having a main surface for supporting a target substrate and a sub-surface disposed around the main surface;

a cooling mechanism disposed in said worktable and configured to supply cold to the main surface and the sub-surface;

a focus ring placed on the sub-surface and configured to surround the target substrate on the main surface; [and]

a heat transfer medium interposed between the sub-surface and said focus ring, said heat transfer medium being disposed so as to improve thermal conductivity between the sub-surface and said focus ring to be higher than in a case with no thermal transfer medium; and

a clamp configured to press said focus ring against the sub-surface,

wherein said cooling mechanism maintains said target substrate and the focus ring at substantially the same temperature.

19. (Amended) The device according to claim [18] 14, [wherein said press mechanism comprises] comprising:

a clamp frame having a contact portion which comes into contact with said focus ring from above, and an extending portion extending downward from the contact portion along a side portion of side worktable.